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Minotti et al.

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(54) **DEVICE FOR BREAKING CONCRETE**

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(52) **U.S. Cl.** **173/89**; 173/11; 173/206; 173/84; 173/115; 299/37.4
(58) **Field of Search** 173/206, 207, 173/89, 86, 184, 115, 28, 4, 11, 84, 114, 113; 404/90, 133.05, 133.1; 299/37.4

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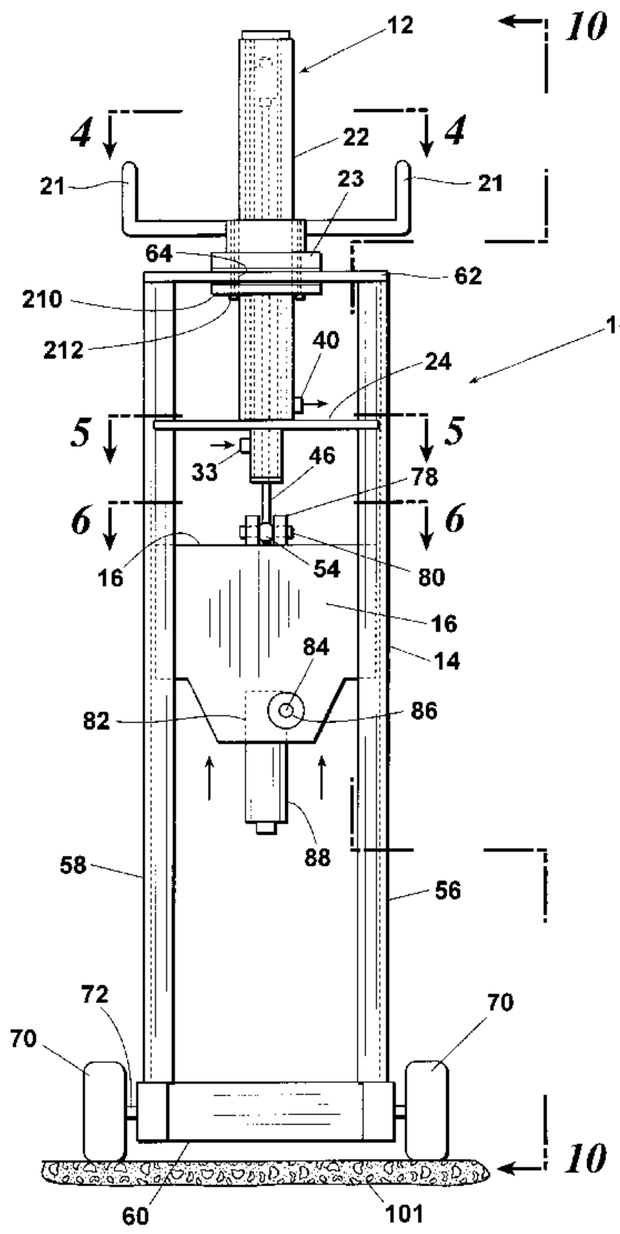
(57) **ABSTRACT**

The present invention provides a device for breaking up a paved surface which attaches to a host transport, such as a skid steer or backhoe, having a hydraulic power supply and preferably comprises a closed hydraulic system which includes a regenerative and concentric type double hydraulic cylinder arrangement adjustably supported within a vertical frame. The cylinder is operably attached to a weight such that when fluid is pumped into a first chamber, a piston drives a rod, thereby lifting a weight while at the same time, the piston forces hydraulic fluid from a second chamber to the host. The piston separates the first chamber from the second chamber within the cylinder. Upon reaching a prescribed height, a valve is opened, allowing fluid to flow from the first chamber into the second chamber, thereby allowing the weight to drop rapidly under the influence of gravity. The inventive device for breaking a paved surface includes an adjustment system for adjusting the vertical position of the cylinder within the frame and a system for preventing operation of the device unless it is properly positioned above the surface for breaking.

15 Claims, 12 Drawing Sheets



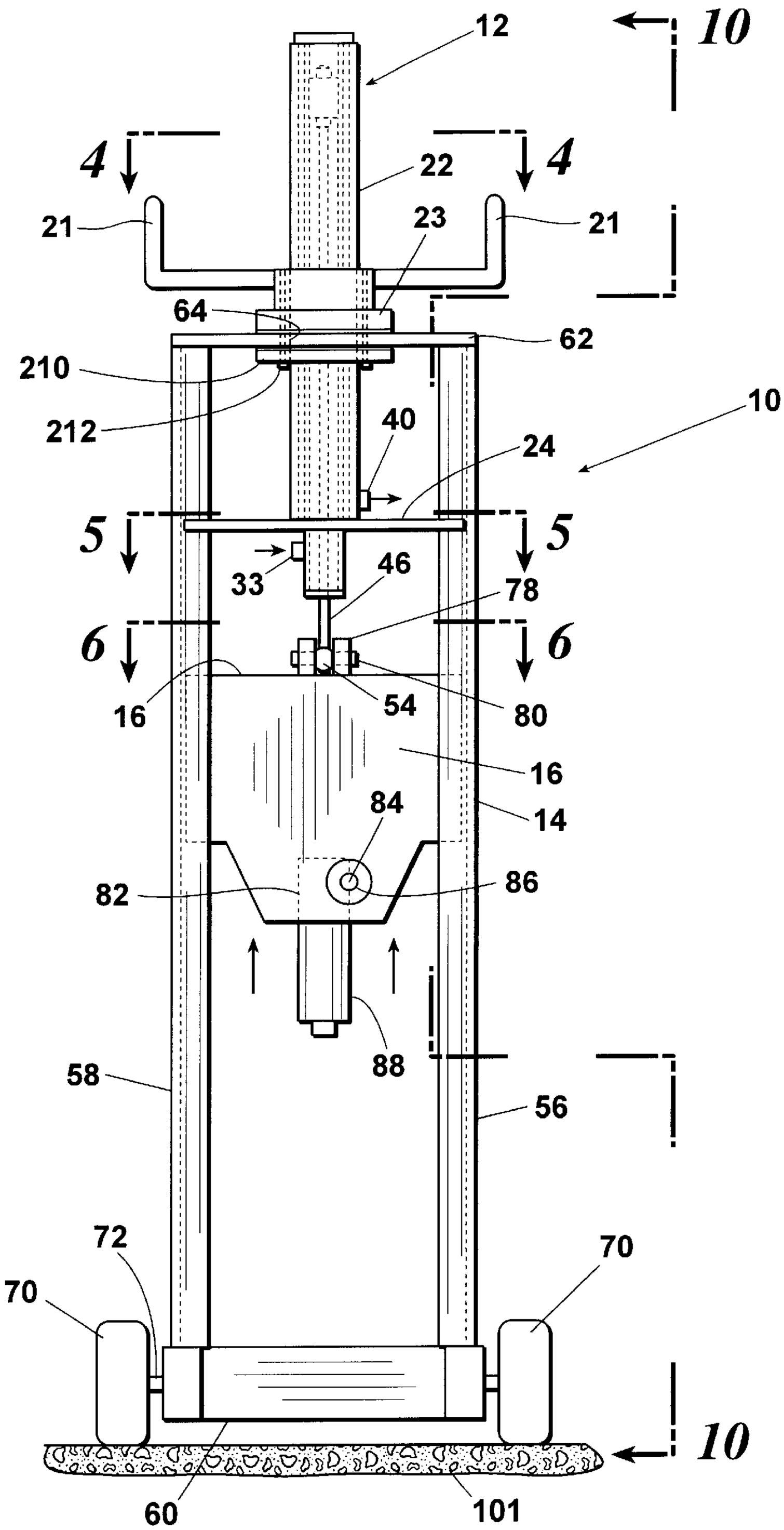

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Fig. 1

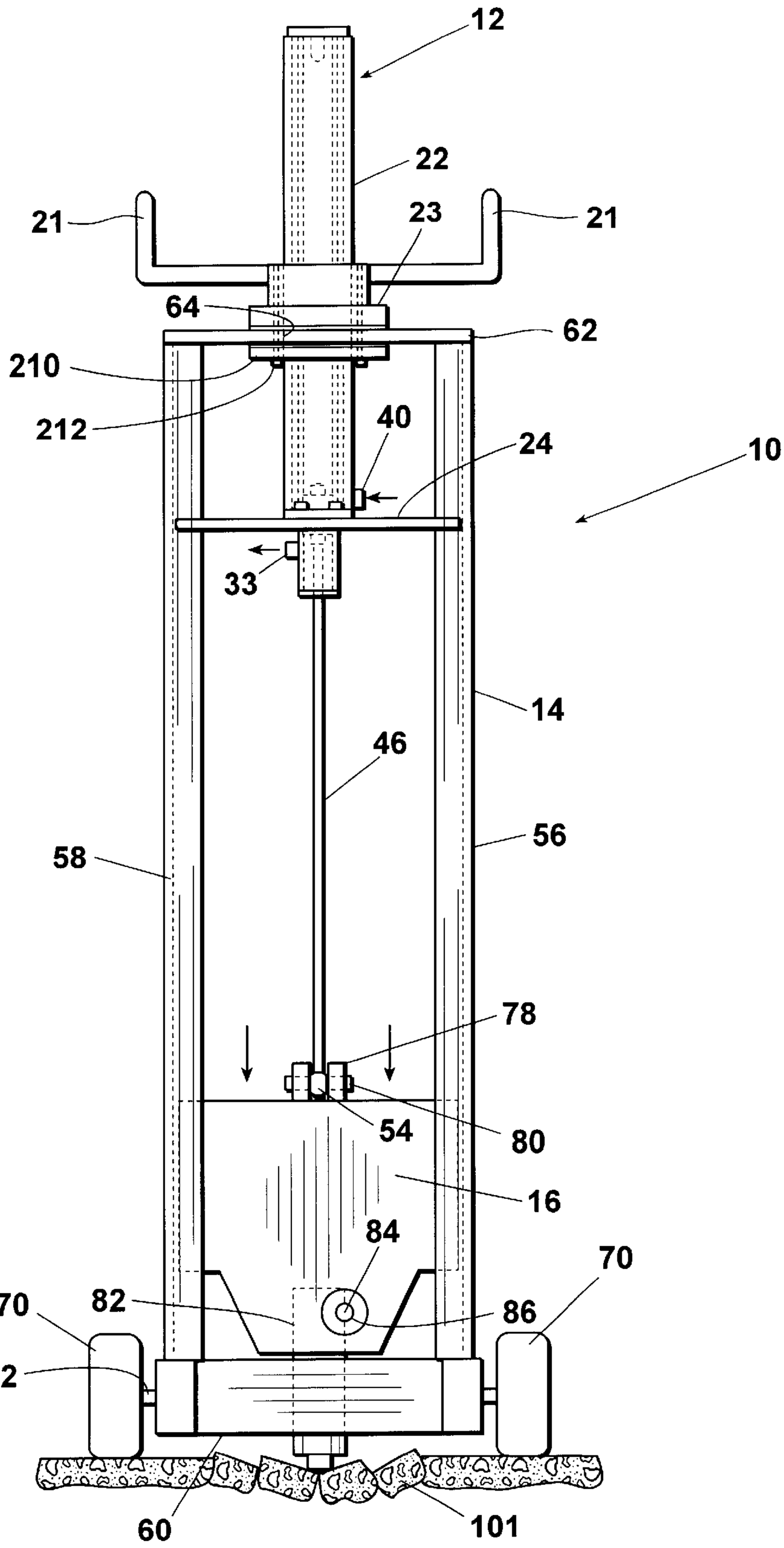
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Fig. 2

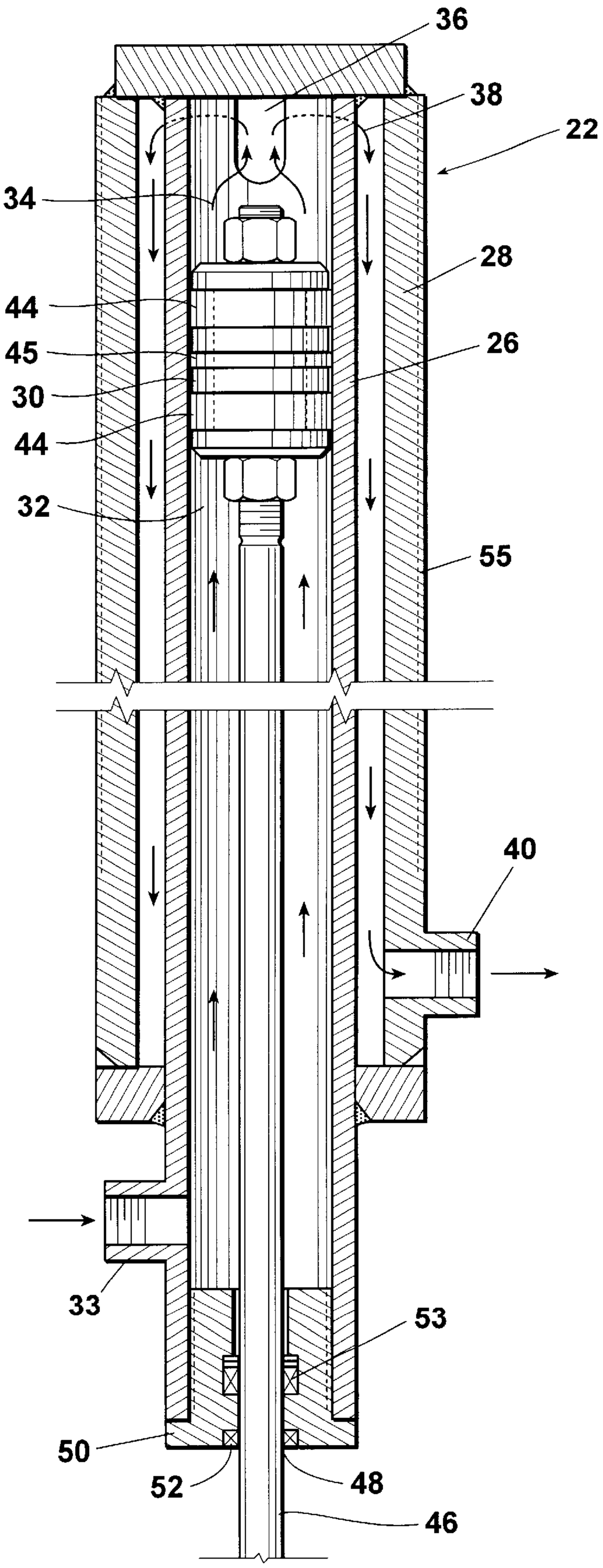
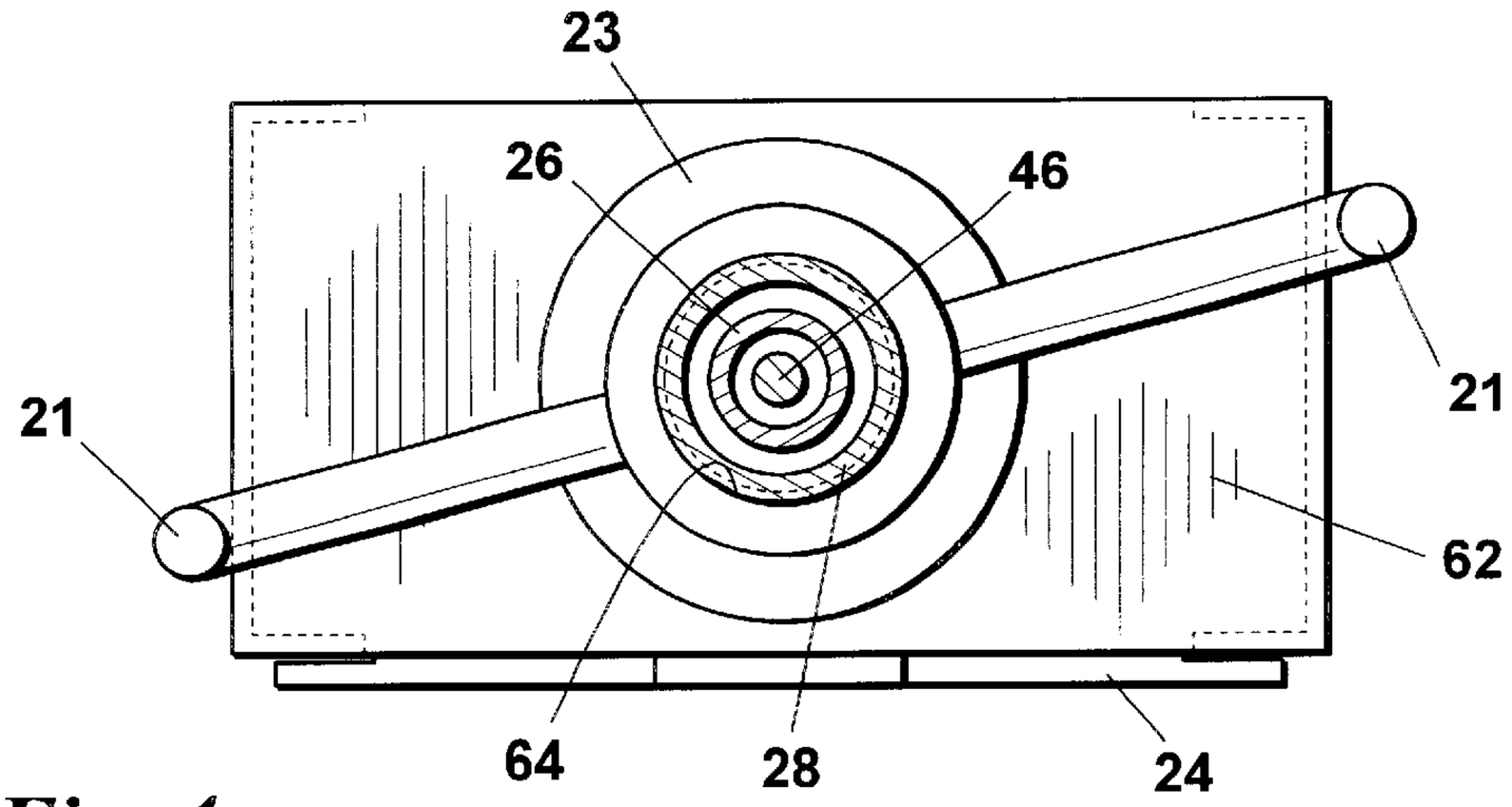


Fig. 3



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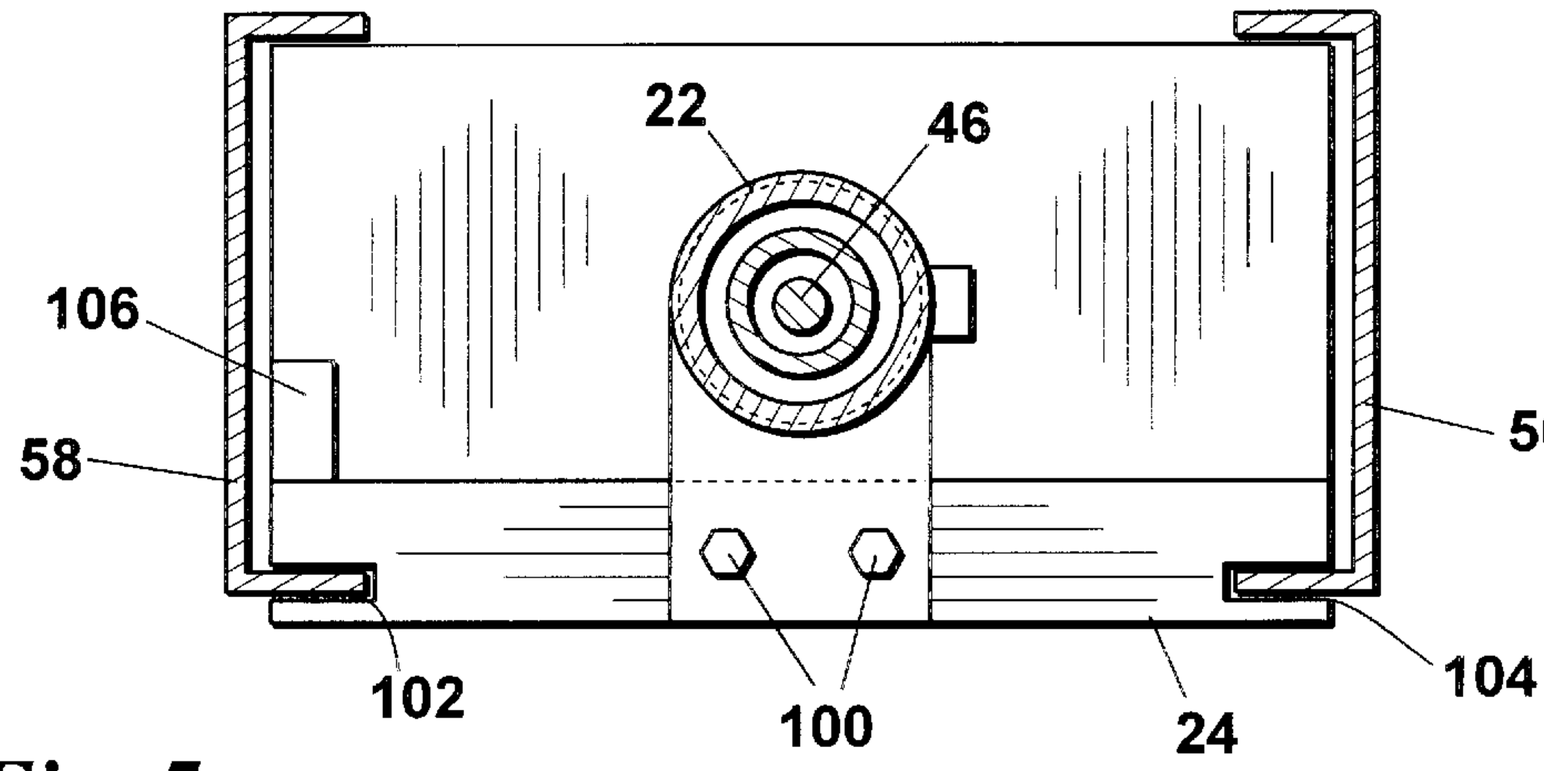


Fig. 5

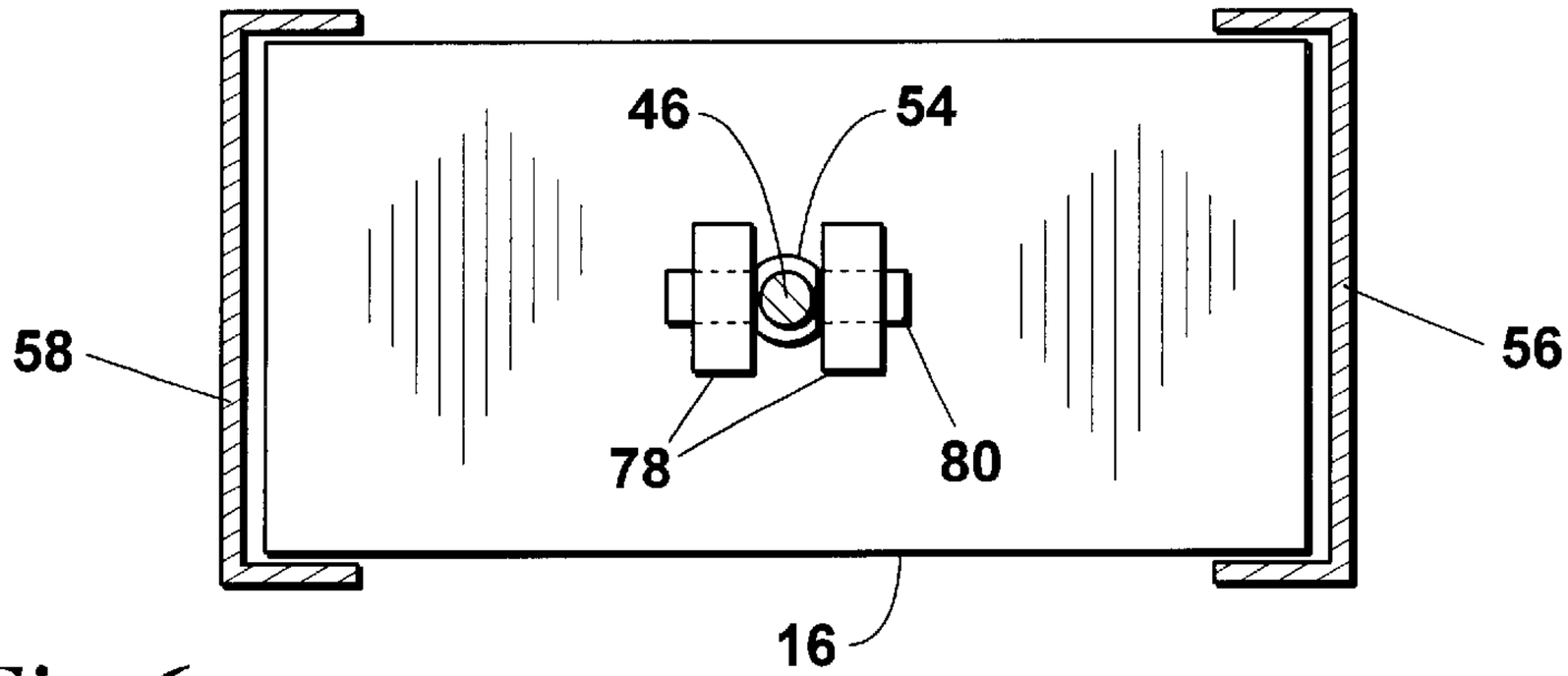


Fig. 6

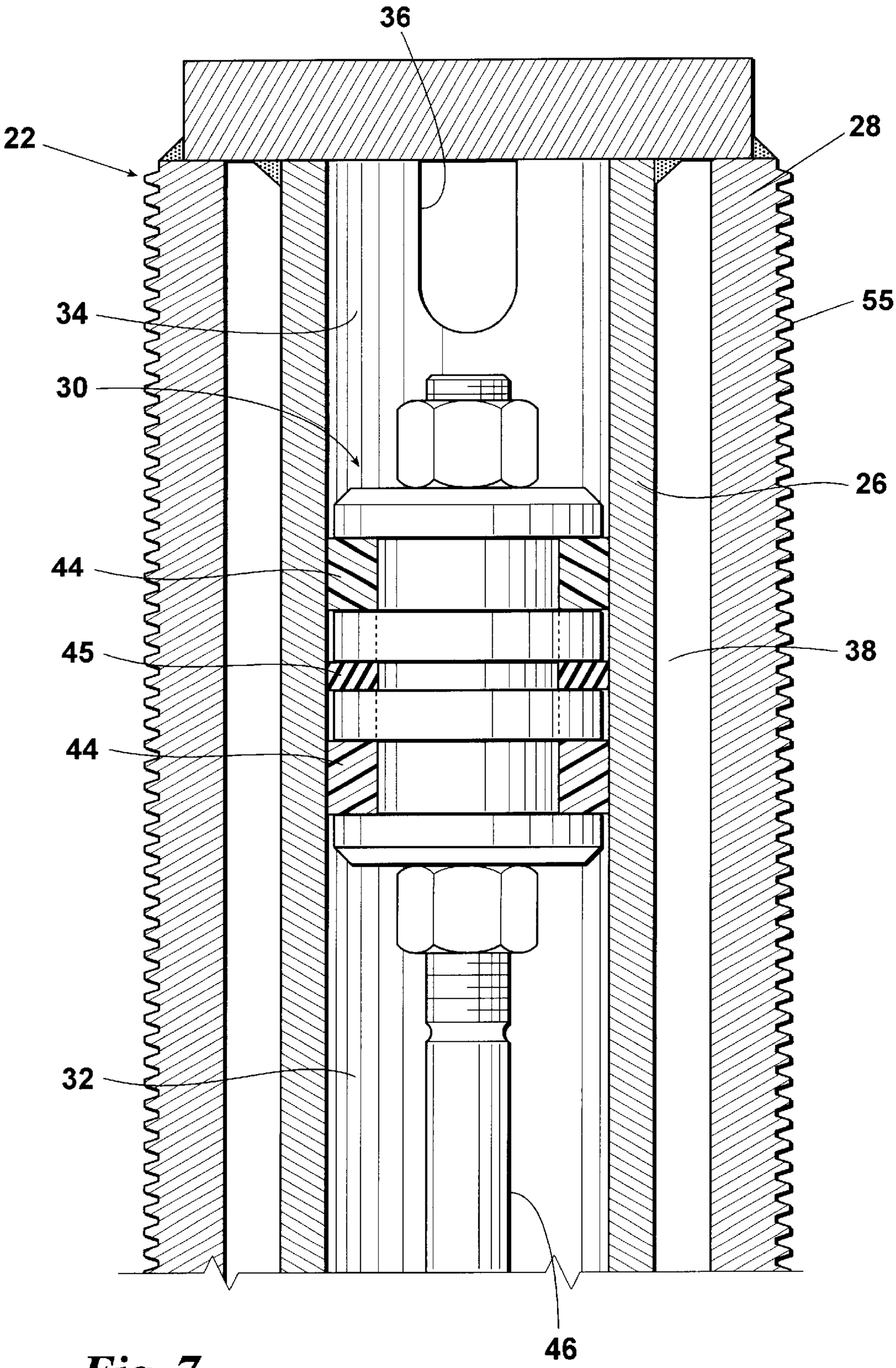
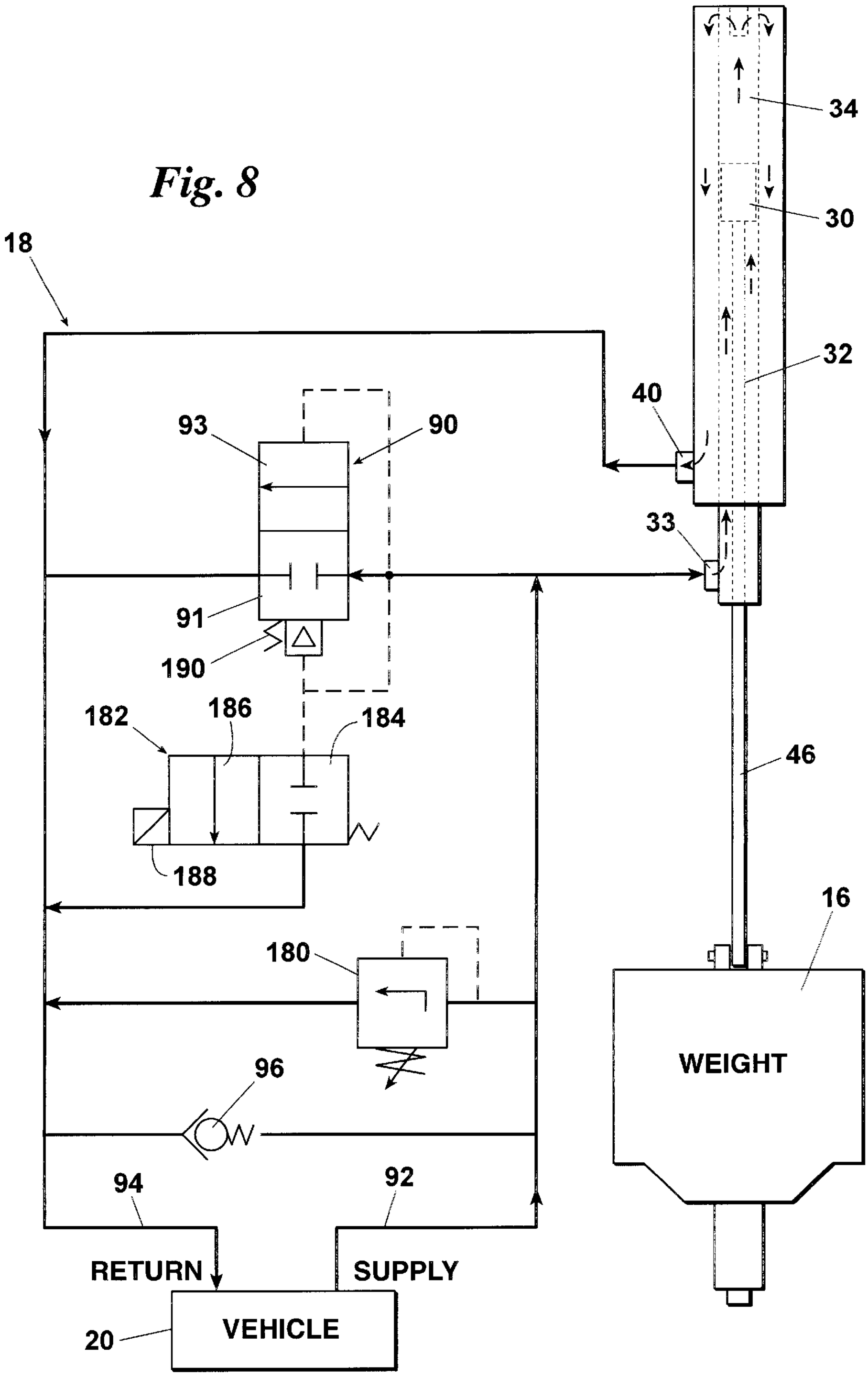


Fig. 7

Fig. 8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WEIGHT
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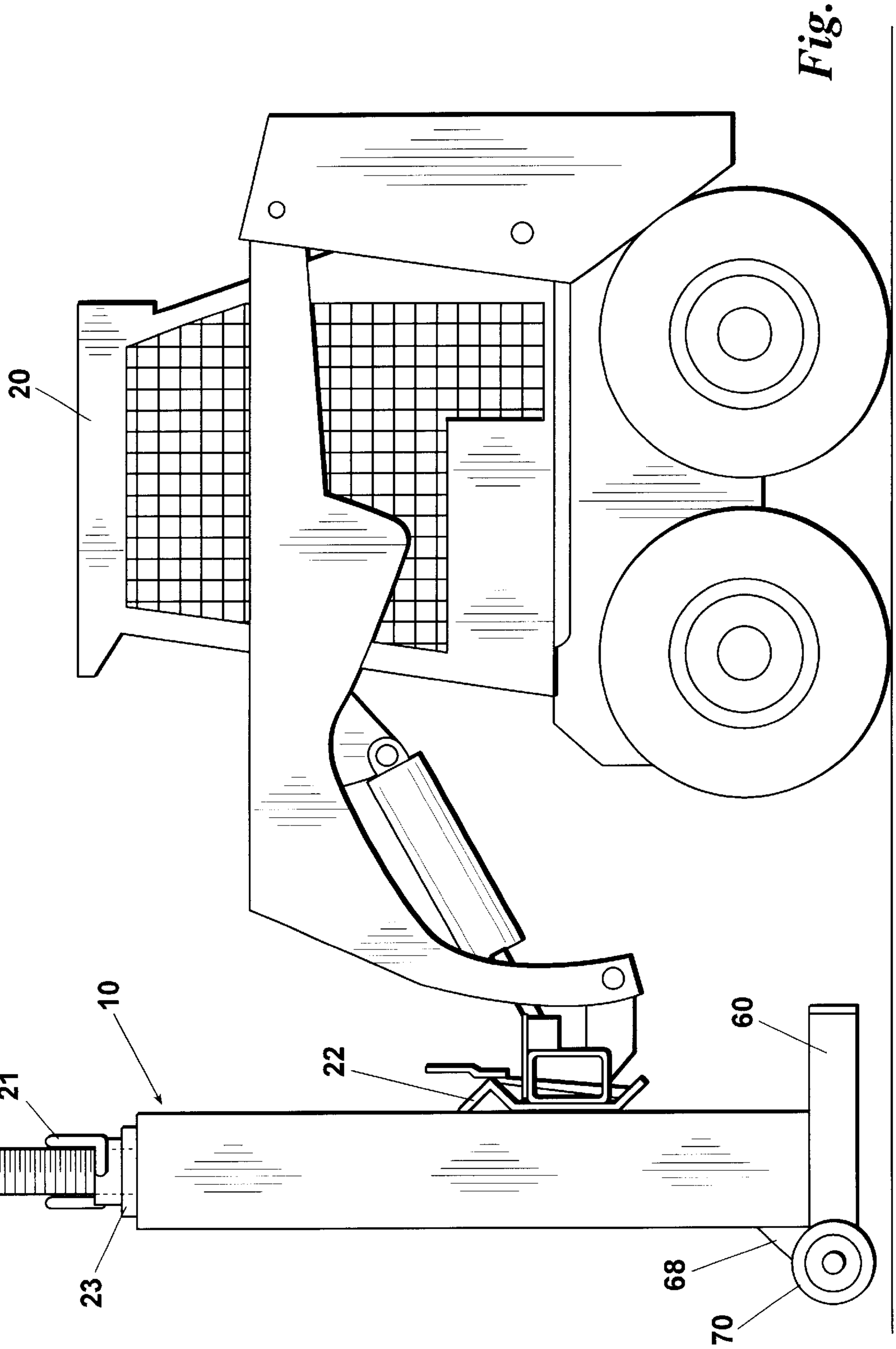
92
RETURN
SUPPLY
20
VEHICLE

Fig. 9



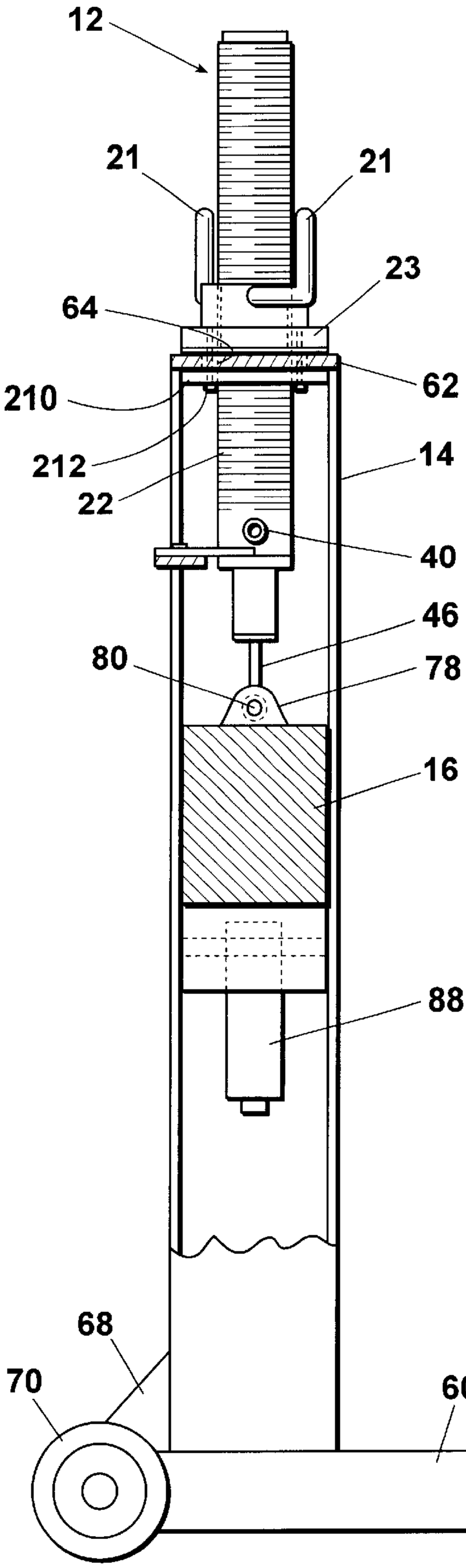

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Fig. 10

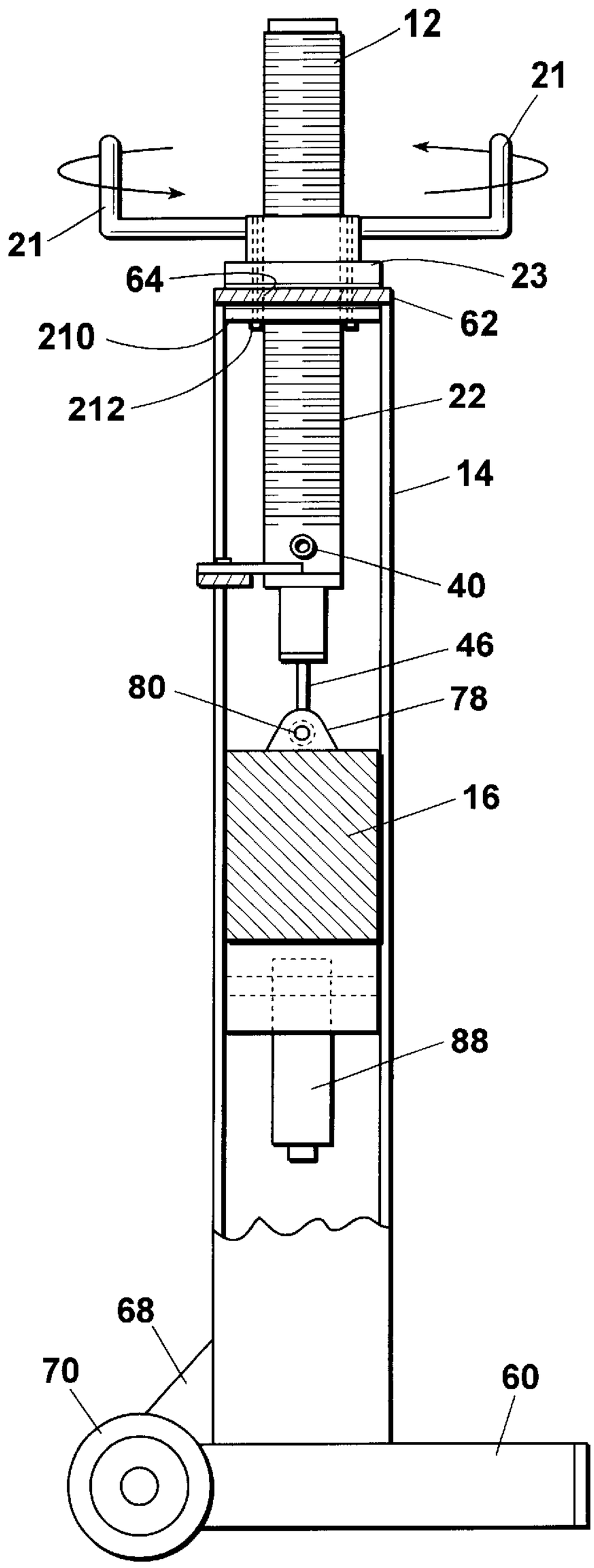
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Fig. 11

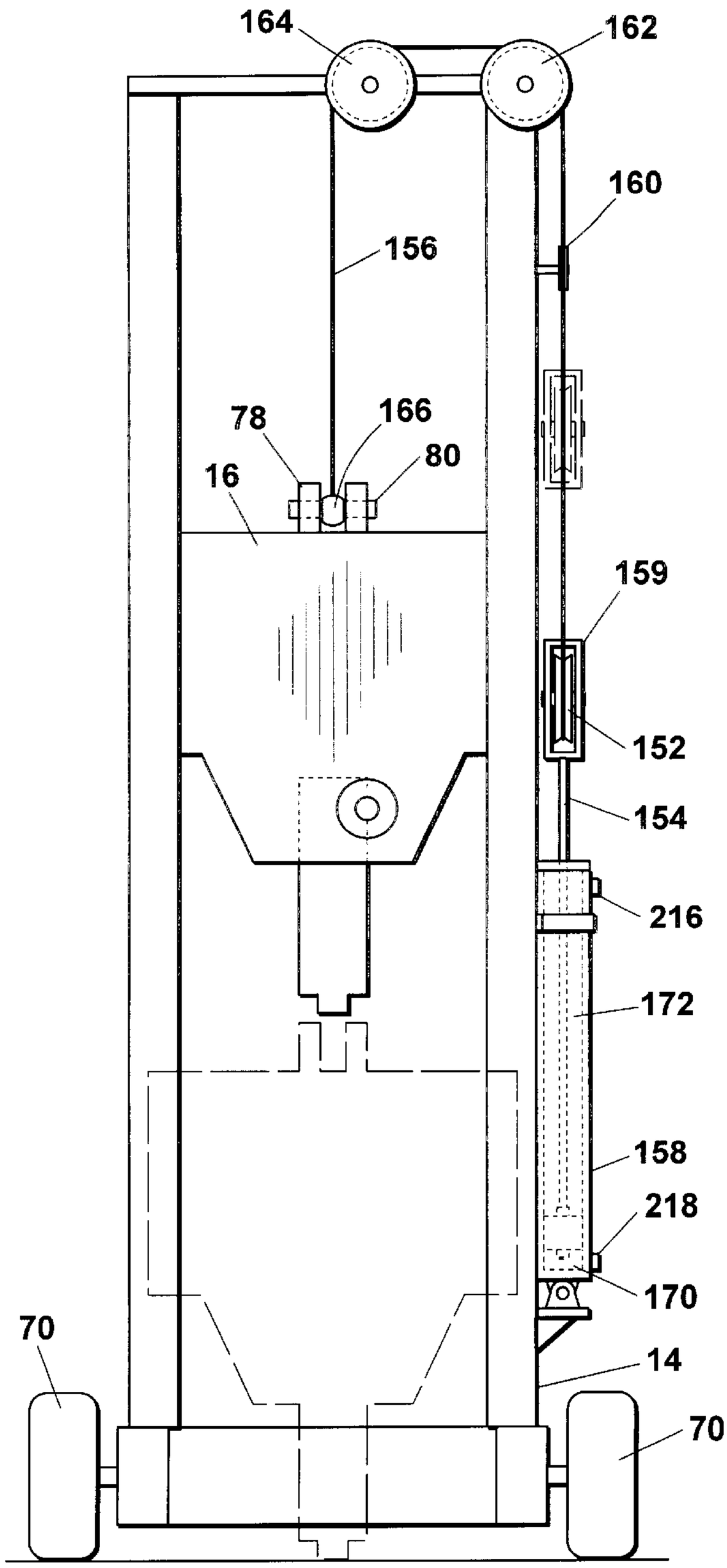
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Fig. 12

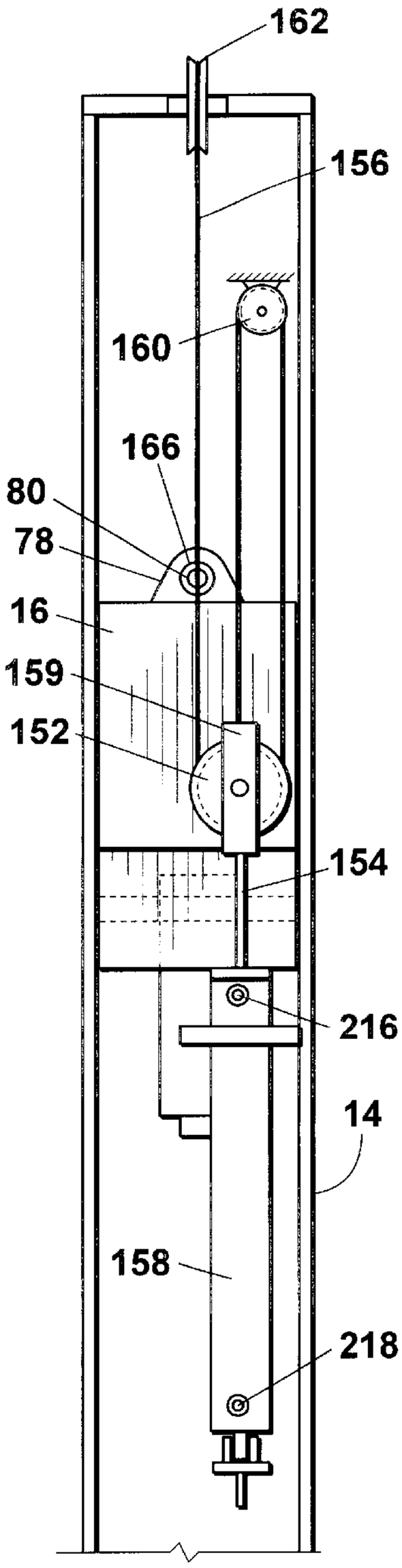
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Fig. 13

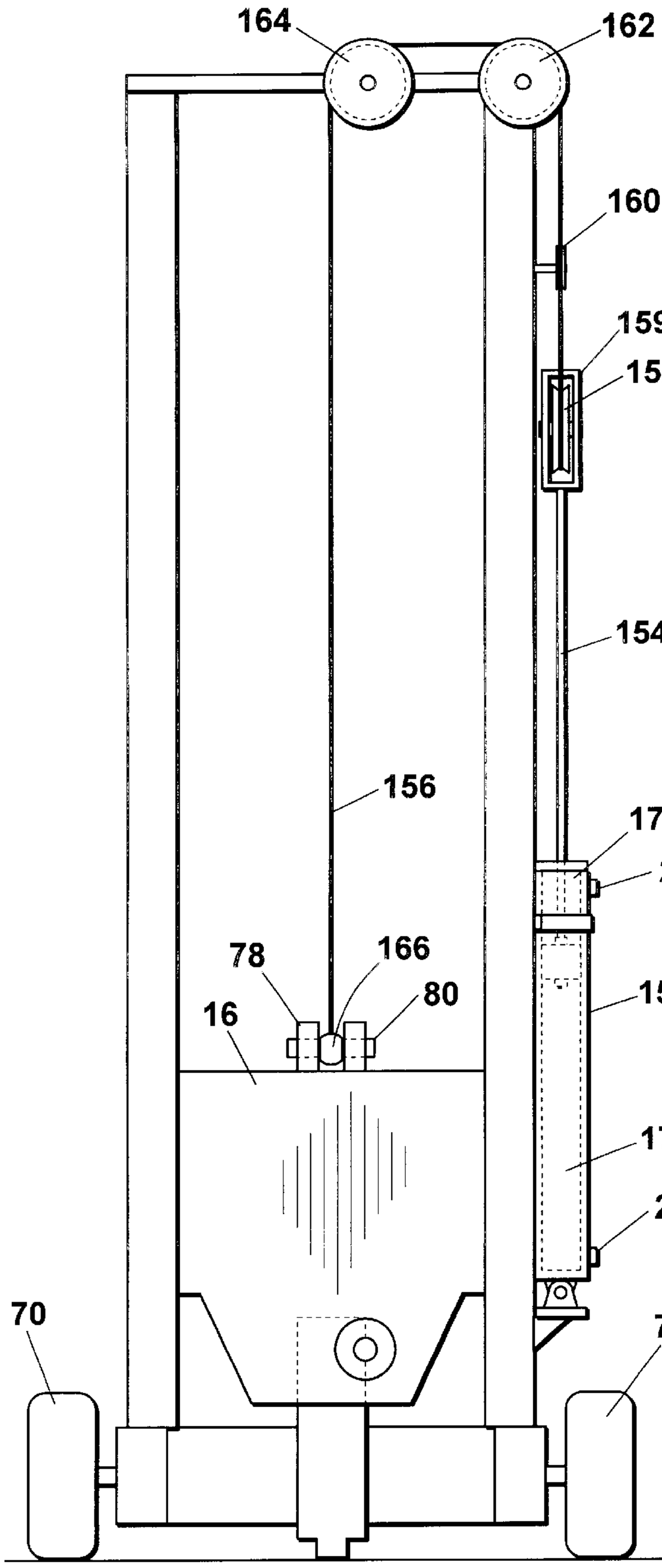
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Fig. 14

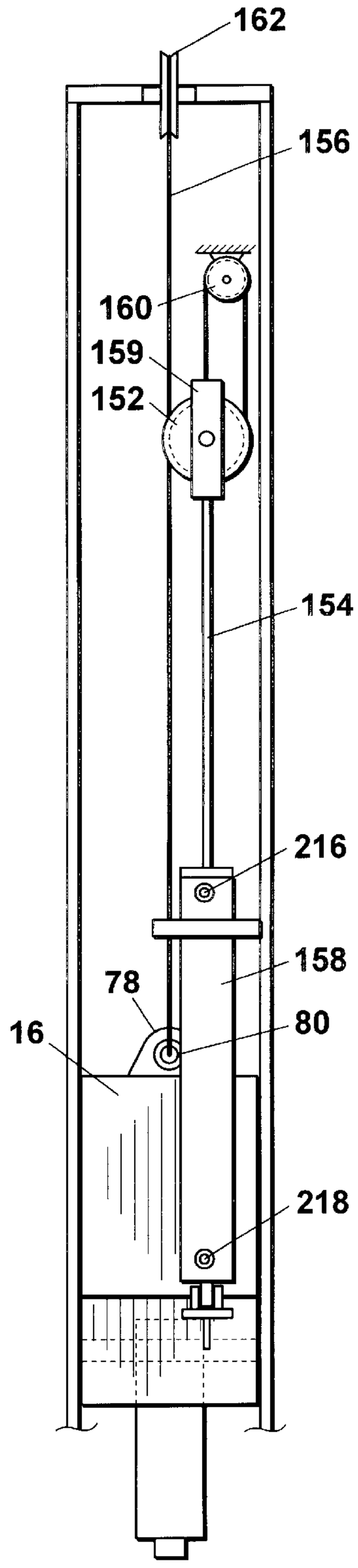
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Fig. 15

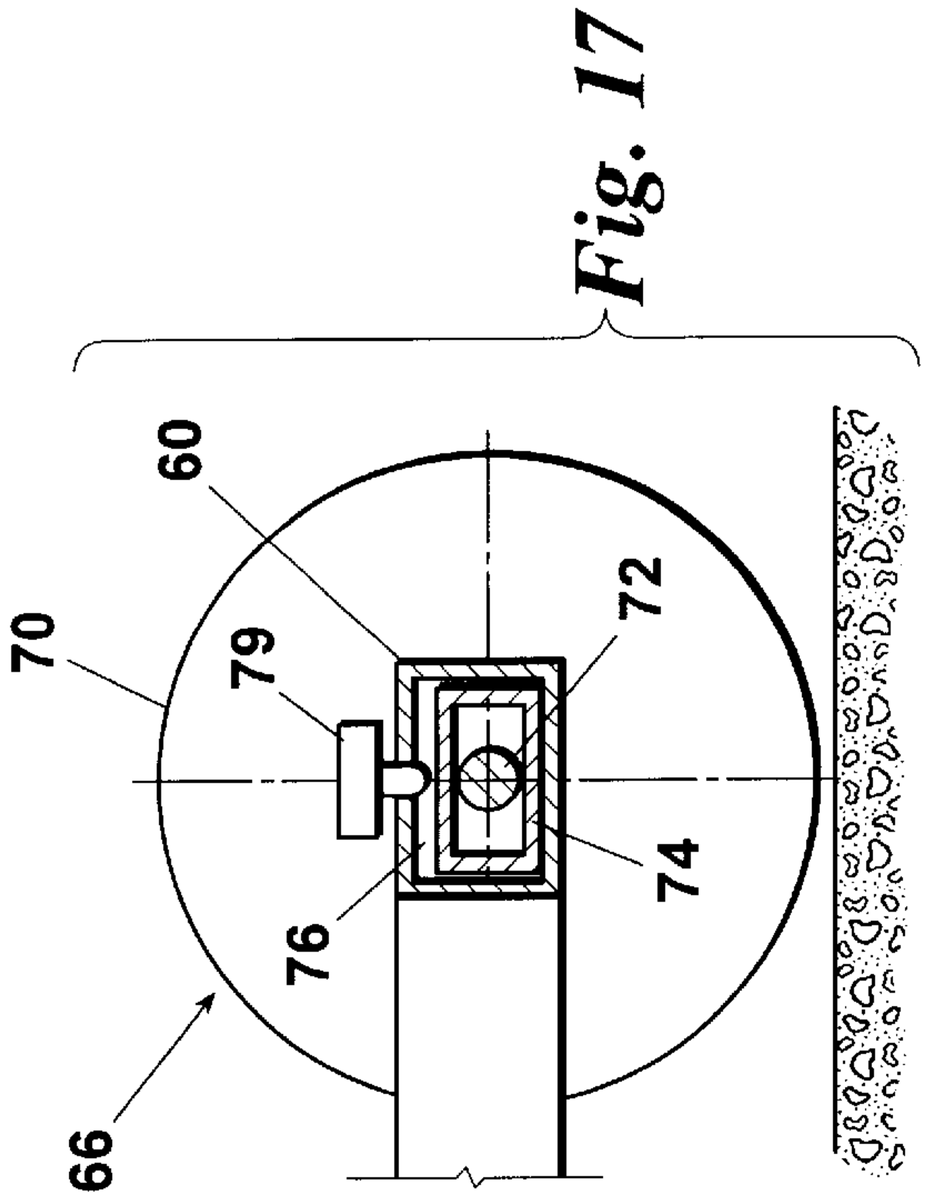

Fig. 17

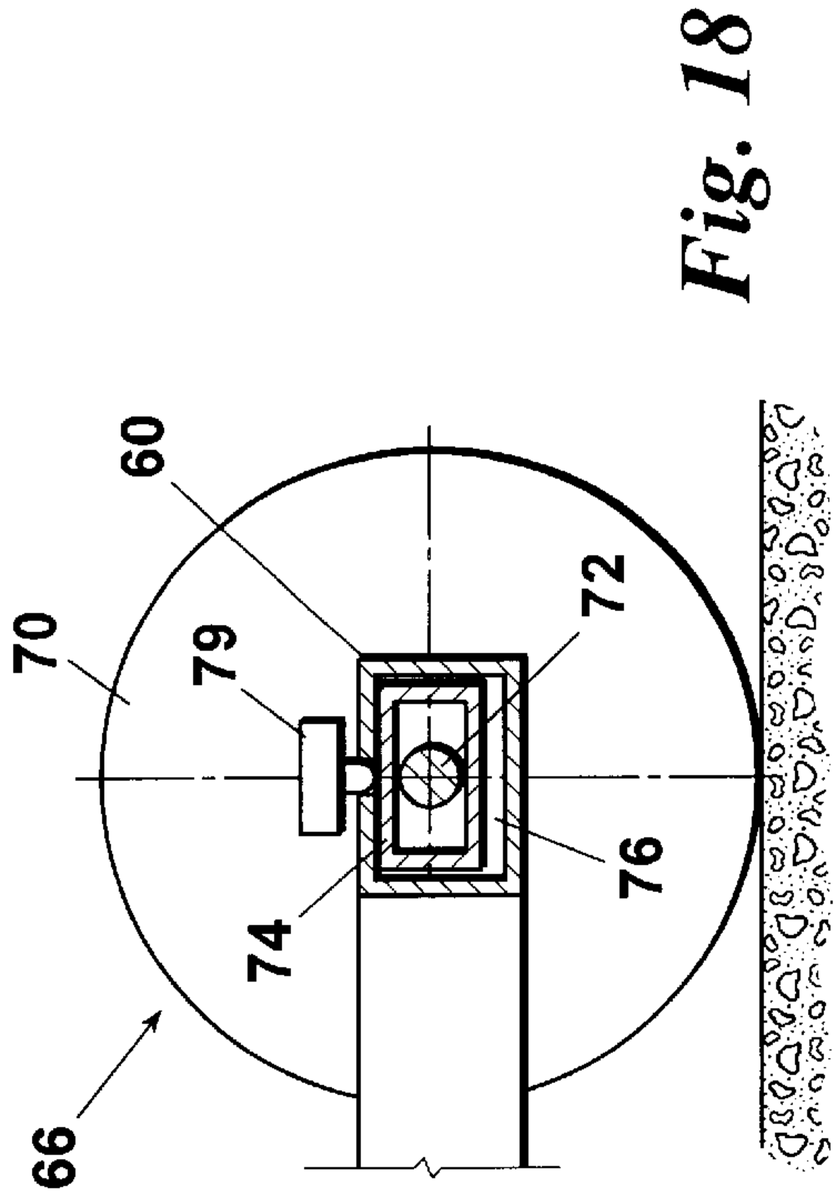

Fig. 18

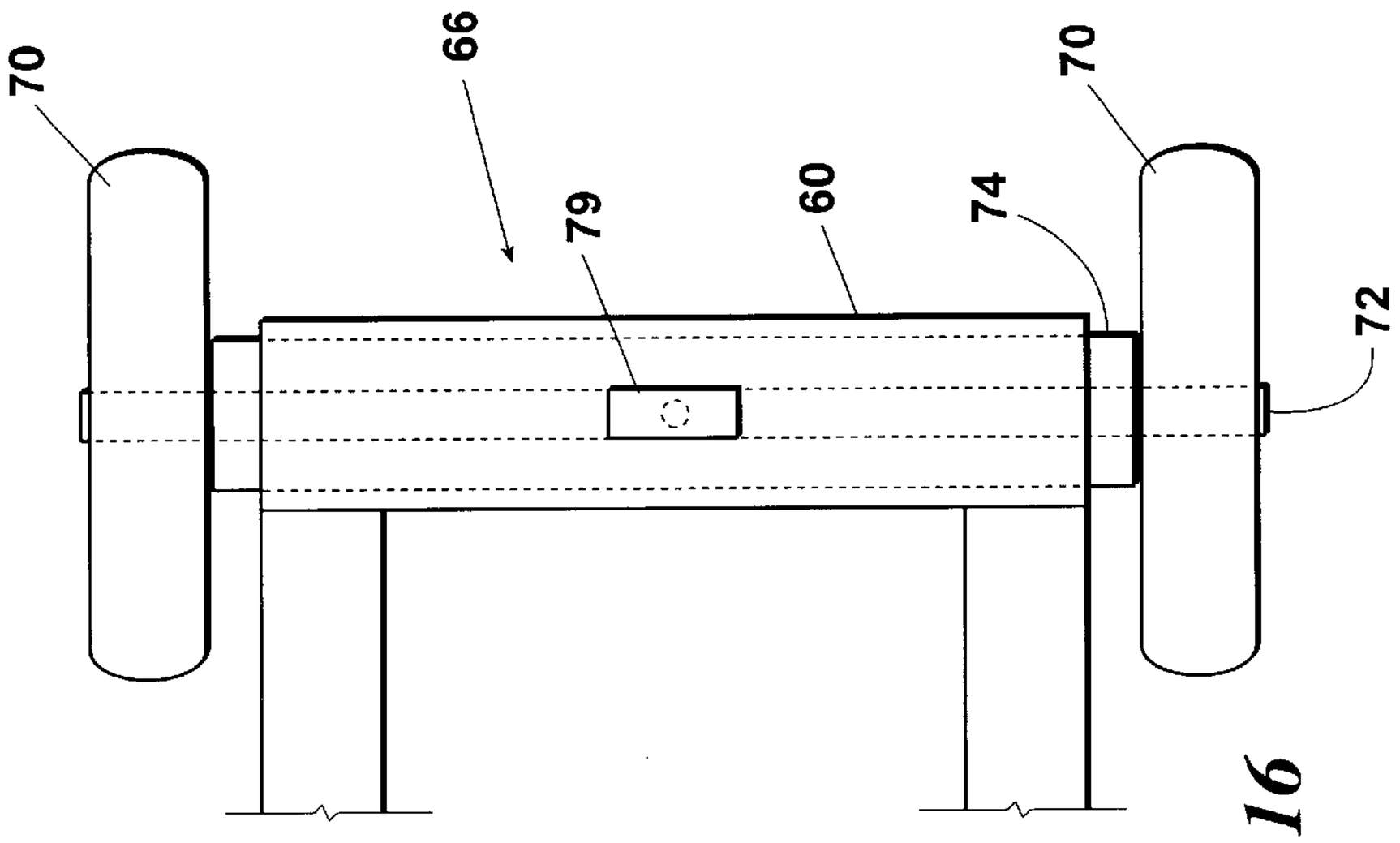

Fig. 16

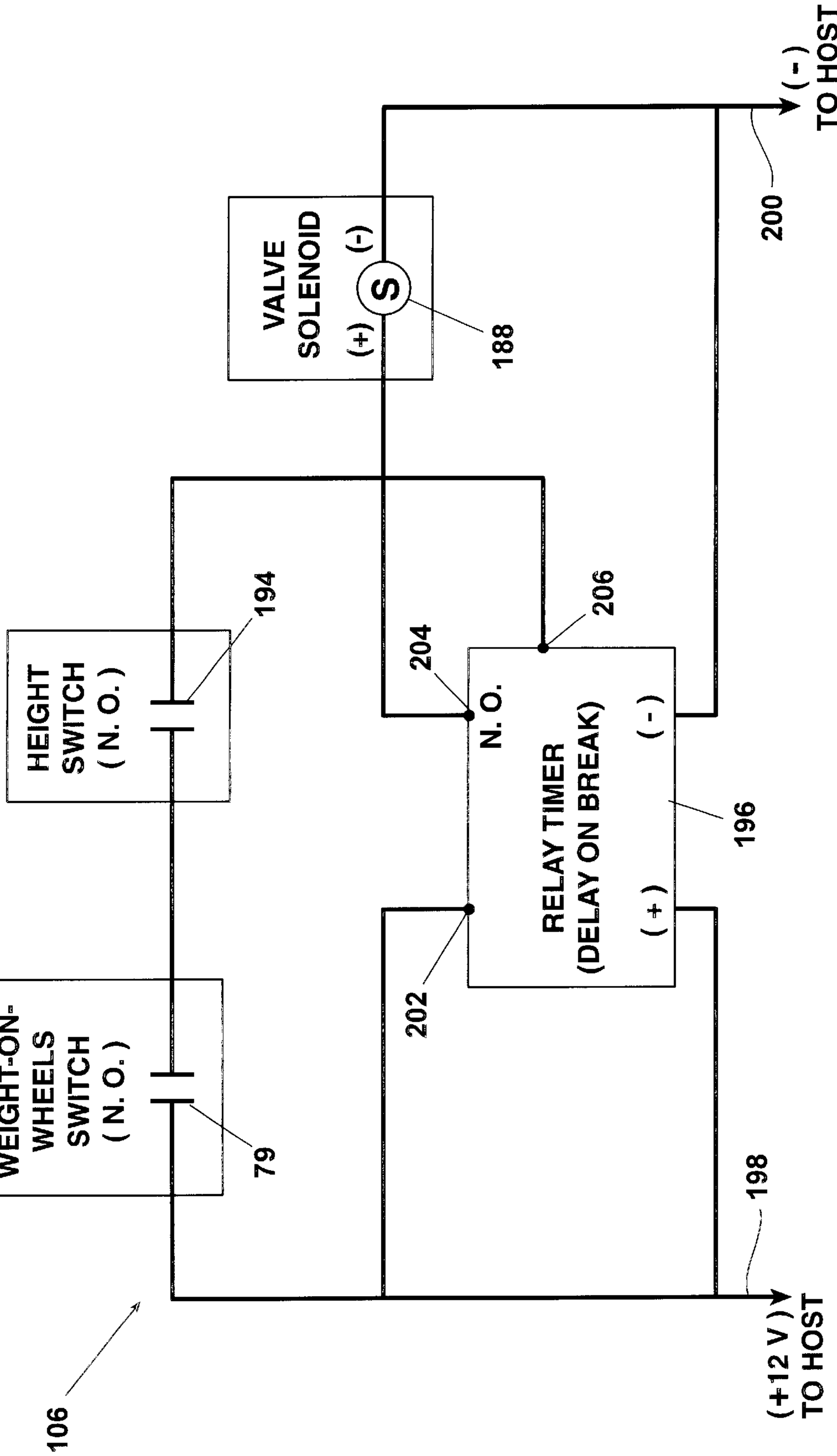
TO HOST (-)
200
VALVE SOLENOID
(-)
(+)
S
188
HEIGHT SWITCH (N.O.)
194
204
N.O.
206
RELAY TIMER (DELAY ON BREAK)
(-)
196
202
(+)
WEIGHT-ON-WHEELS SWITCH (N.O.)
79
198
106
(+12 V) TO HOST

Fig. 19

DEVICE FOR BREAKING CONCRETE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to devices for breaking concrete. More particularly, but not by way of limitation, the present invention relates to a drop hammer for breaking concrete, asphalt, etc. which is mounted to a skid steer or back hoe.

2. Background

When paved surfaces such as roadways or parking lots are in need of repair or resurfacing, there is often a need to break up the existing surface for removal. In the past, this has been accomplished with specialized and dedicated equipment. These dedicated pieces of equipment typically require a substantial investment and are limited to the single task of breaking up a surface.

Previous devices, such as the one disclosed in U.S. Pat. No. 5,607,022 ("the '022 patent") have been developed which attach to existing equipment such as a skid steer. These devices reduce the equipment cost but have exhibited limitations in their performance. For example, the device disclosed in the '022 patent uses a hydraulic cylinder to lift a weight wherein hydraulic fluid is first pumped from a reservoir into the hydraulic cylinder causing the cylinder rod to extend. When the weight reaches a preselected height, a trip switch is activated which opens a dump valve thereby allowing fluid to flow from the hydraulic cylinder back into the reservoir as the cylinder rod is retracted by the falling weight. Unfortunately, the rate at which the weight falls is limited by restrictions on the flow of the hydraulic fluid from the hydraulic cylinder to the reservoir. The flow rate is thus limited by factors such as the diameter and length of the hydraulic lines, some of which are integral to the skid steer. In particular, the hydraulic return line of the skid steer which returns hydraulic fluid to the reservoir often proves to be the limiting factor in determining the drop rate of the weigh. Accordingly, unless a separate hydraulic system is employed, requiring a pump, motor, reservoir, and cooling system, the drop rate is limited by factors which are outside of the control of the supplier of the breaker. A need, therefore, exists for a hydraulic system for a concrete breaker which will support the flow rate of hydraulic fluid necessary to achieve a satisfactory drop rate of the weight, independent of the flow rate sustainable by the skid steer and without substantial additional hydraulic subsystems.

In addition, the hydraulic system disclosed in the '022 patent is not a closed system. As the cylinder is filled to lift the weight, fluid is drawn from the reservoir, and, conversely, as the weight falls and the cylinder is emptied, fluid is returned to the reservoir. Obviously, the reservoir must be able to accommodate these fluctuations in the volume of fluid stored within the reservoir. This is typically accomplished by venting the reservoir to the atmosphere. Venting in a cyclic hydraulic system, such as the system typically employed in a breaker, causes air to continuously be drawn in to, and subsequently expelled from, the reservoir. This is of particular concern at a construction site where the air may have a relative high concentration of dust and other particulate matter as is usually the case where the existing pavement is being broken and removed. A need also exists, therefore, for a concrete breaker which does not require a reservoir, or if a reservoir is already present on the skid steer, minimizes fluctuations in the fluid level in the reservoir during operation of the breaker.

Finally, there often exists a need to transport, and even operate, a concrete breaker where overhead obstructions are a concern. Previous devices have typically been of a fixed height. Accordingly, a need exists for a concrete breaker wherein the overall height of the device may be adjusted downward for transportation or operation in vertically confirmed spaces, or adjusted upward for more effective operation in spaces where overhead clearance is not a concern.

SUMMARY OF THE INVENTION

The present invention provides a device for breaking up a paved surface which satisfies the needs and alleviates the problems discussed above. The inventive apparatus attaches to a host, such as a skid steer or backhoe, having a hydraulic power supply and preferably comprises a closed hydraulic system which includes a regenerative type hydraulic cylinder arrangement adjustably supported within a vertical frame. The cylinder is operably attached to a weight such that when fluid is pumped into a first chamber from the host, a piston disposed between the first chamber and a second chamber drives a rod, thereby lifting a weight. At the same time, the piston forces hydraulic fluid from the second chamber back to the host. Upon reaching a prescribed height, a valve is opened, allowing fluid to flow from the first chamber into the second chamber on the other side of the piston, thereby allowing the weight to drop rapidly under the influence of gravity. This is an important aspect of the present invention because the required volumetric flow rate is very large to allow the weight to fall freely. The rapid flow of fluid from the first chamber into the second chamber is a function of the above described structure of the inventive device and is thus independent of the diameter and length of hydraulic lines provided on the skid steer. A tool attached to the weight strikes the paved surface at the bottom of travel of the weight, breaking up the surface.

Since hydraulic fluid is forced from the second chamber by the piston as fluid is pumped into the first chamber, and likewise, since fluid forced from the first chamber, as the weight falls, fills the second chamber, the volumetric rate of fluid drawn from or returned to a reservoir is reduced to within the host's operating range.

The regenerative concentric type double hydraulic cylinder arrangement includes a threaded cylindrical outside surface which receives an adjustment nut wherein the vertical position of the cylinder relative to the frame may be adjusted. The overall height of the inventive device may be adjusted to a relatively low position for transportation or operation where overhead clearance is a concern or adjusted to a higher position for more effective breaking where no such concern exists.

It is thus an object of the present invention to provide a device for a breaking up a paved surface which may be attached to existing equipment such as a skid steer or backhoe.

It is a further object of the present invention to provide a device for breaking up a paved surface which incorporates a regenerative double hydraulic cylinder arrangement wherein restrictions in the flow of hydraulic fluid while a weight is dropped, are substantially independent of the hydraulic system of the host skid steer or backhoe thereby allowing the weight to fall at a higher rate than achieved by previous devices.

It is still a further object of the present invention to provide a device for breaking up a paved surface which utilizes a closed hydraulic system such that a reservoir and other necessary related subsystems my be eliminated or, if a reservoir is present, fluctuations in the amount of fluid in the reservoir are reduced to an insignificant level.

It is yet a further object of the present invention to provide a device for breaking up a paved surface wherein the position of the hydraulic cylinder relative to the frame is adjustable to accommodate a variety of operating conditions and to improve transportability of the inventive device.

Further objects, features, and advantages of the present invention will be apparent to those skilled in the art upon examining the accompanying drawings and upon reading the following detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an elevational front view of a preferred embodiment **10** of the inventive device for breaking a paved surface showing the weight in a lifted position.

FIG. **2** is an elevational front view of the inventive device for breaking a paved surface showing the weight in a dropped position.

FIG. **3** is a cutaway view of concentric type double hydraulic cylinder **22** incorporated in the inventive device for breaking a paved surface.

FIG. **4** is an elevational top view of the concentric type double hydraulic cylinder **22** and adjustment nut **23** incorporated in the inventive device for breaking a paved surface.

FIG. **5** is an elevational top view of the concentric type double hydraulic cylinder **22** and cylinder retainer **24** incorporated in the inventive device for breaking a paved surface.

FIG. **6** is an elevational top view of the weight **16** and clevis **54** incorporated in the inventive device for breaking a paved surface.

FIG. **7** is a cutaway detail of the concentric type double hydraulic cylinder **22** showing the outside threaded surface thereof.

FIG. **8** is a hydraulic schematic diagram for the closed hydraulic system **18** incorporated in the inventive device for breaking a paved surface.

FIG. **9** is an elevational side view showing the general environment of the device for breaking a paved surface.

FIG. **10** is an elevational side view of the device for breaking a paved surface shown with the regenerative type double hydraulic cylinder **22** shown adjusted to a first position.

FIG. **11** is an elevational side view of the device for breaking a paved surface shown with the regenerative type double hydraulic cylinder **22** shown adjusted to a second, lower position.

FIG. **12** is an elevational front view of an alternate embodiment **150** of the device for breaking a paved surface shown with the weight **16** in a lifted position with the dropped position shown in phantom.

FIG. **13** is an elevational side view of alternate embodiment **150** of the device for breaking a paved surface shown with the weight **16** in a lifted position.

FIG. **14** is an elevational front view of alternate embodiment **150** of the device for breaking a paved surface shown with weight **16** in a dropped position.

FIG. **15** is an elevational side view of alternate embodiment **150** of the device for breaking a paved surface shown with weight **16** in a dropped position.

FIG. **16** is an elevational top view of the base **60** of the device for breaking a paved surface.

FIG. **17** is a cutaway side view showing the weight-on-wheels switch **79** in a non-actuated state as incorporated in the inventive device for breaking a paved surface.

FIG. **18** is a cutaway side view showing the weight-on-wheels switch **79** in an actuated state as incorporated in the inventive device for breaking a paved surface.

FIG. **19** is an electrical diagram of the timer circuit **106** of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment **10** of the inventive device for breaking concrete is shown in FIGS. **1–11** and **16–18**. As best seen in FIG. **1**, the device for breaking concrete **10** comprises: cylinder assembly **12**; vertical frame **14** supporting cylinder assembly **12**; weight **16** slidably retained in and capable of vertical travel within frame **14**; closed hydraulic system **18** (FIG. **8**); and mounting bracket **22** (FIG. **9**) for attaching the inventive device to a suitable host **20**, preferably a skid steer or backhoe.

As used herein, the term "breaker" refers to the inventive device for breaking concrete **10**

As is best seen in FIG. **3**, in the preferred embodiment **10**, cylinder assembly **12** includes a concentric type double hydraulic cylinder **22** in a regenerative circuit arrangement (described below), adjustment nut **23**, and cylinder retainer **24**. As is shown, cylinder **22** is of a double "cylinder within a cylinder" arrangement wherein the inner cylinder **26** and outer cylinder **28** are arranged in a concentric fashion for manufacturing and fluid flow convenience. However, it is understood by those of skill in the art that inner cylinder **26** may be positioned in an eccentric arrangement with respect to the outer cylinder **28** while still being in a double cylinder arrangement without departing from the scope of the invention.

As best seen in FIG. **3** taken in combination with FIG. **7**, double cylinder **22** has inner cylinder **26** partially contained in outer cylinder **28**. Inner cylinder **26** houses piston **30** such that first chamber **32** and second chamber **34** are created respectively below and above piston **30**. FIG. **3** shows the hydraulic fluid flow pattern for a lifting mode wherein piston **30** is forced by hydraulic fluid pressure within first chamber **32** toward second chamber **34**.

Inner cylinder **26** includes port **36** towards its upper end which allows fluid to freely flow bidirectionally between second chamber **34** and annular gap **38** located between outer cylinder **28** and inner cylinder **26**. A threaded port **40** receives a fitting on a hydraulic line and is provided at the lower end of outer cylinder **28** to provide a path for hydraulic fluid to flow into and out from (as shown in FIG. **3**) gap **38**. As will be shown herein below, advantages are realized by providing port **40** at the lower end of outer cylinder **28**. Threaded port **33**, providing fluid access to first chamber **32**, is located at the lower end of inner cylinder **26**.

It is a characteristic of first chamber **32** and second chamber **34** that their respective volumes vary depending on the position of piston **30** such that as piston **30** moves upward, first chamber **32** will increase in volume while second chamber **34** decreases proportionately in volume. Conversely, when piston **30** moves in the downward, first chamber **32** decreases in volume while second chamber **34** proportionately increases in volume.

Regenerative, in regards to hydraulic cylinder **22**, refers to a hydraulic circuit arrangement wherein, as the cylinder rod extends under the influence of a falling weight, fluid is forced from the first chamber **32** into second chamber **34** with minimum involvement of any hydraulic system elements located external to the breaker **10**. First chamber **32** is thus in direct fluid communication with second chamber **34**.

Furthermore, it will be apparent to those skilled in the art that if, during the dropping cycle, the hydraulic pressure in first chamber **32** is the same as the hydraulic pressure in second chamber **34**, there will be a net force pushing downward on rod **46**. This results from the fact that the pressure in second chamber **34** acts over a larger surface area of the piston **30** than does the pressure in first chamber **32** due to the area taken up by rod **46**.

Piston **30** preferably includes at least one rider band **44** (two shown in the preferred embodiment) which prevents excessive rubbing between piston **30** and inner cylinder **26** and seal **45** which prevents hydraulic fluid from undesirably leaking between first chamber **32** and second chamber **34**. Rod **46** is connected to piston **30** and extends through aperture **48** in cylinder gland cap **50** of cylinder **22**. Cap **50** houses wiper bushing **52** and gland seal **53** about aperture **48** which prevent hydraulic fluid from leaking between aperture **48** and rod **46**. Clevis **54** (FIG. **1**) is operably (threadedly) engaged to the end of rod **46** opposite piston **30**. In the preferred embodiment, clevis **54** is a ball joint clevis.

Preferably, as also shown in FIGS. **7** and **1**, the outside surface **55** of outer cylinder **28** is provided with an Acme screw thread to receive adjustment nut **23**, such that nut **23** may be selectively positioned along the length of outer cylinder **28**. This selective positioning controls the drop height of weight **16** (FIG. **1**).

Referring next to FIG. **5**, cylinder retainer **24** attaches to cylinder **22** with bolts **100**. Retainer **24** is slidably received within frame **14** such that left slot **102** receives left upright channel **56** and right slot **104** receives right upright channel **58** of frame **14**. Retainer **24** prevents cylinder **22** from turning when nut **23** is rotated.

Referring once again to FIG. **1**, the components of frame **14** shall be described. Frame **14** comprises left upright channel **56** and right upright channel **58** connected between top plate **62** at the upper end and base **60** at the lower end such that upright channels **56** and **58** are substantially vertical and parallel.

Flange **210** is attached to adjustment nut **23** with bolts **212** to sandwich top **62** and locate nut **23** about aperture **64**. When assembled, hydraulic cylinder **22** is threadedly received in nut **23**, passing through flange **210** and aperture **64**. Flange **210** below plate **62** cooperates with adjustment nut **23** above plate **62** to prevent unwanted vertical movement of the hydraulic cylinder **22** during times when the hydraulic fluid pressure in inner cylinder **32** exerts some downward force on rod **46**. As shown in FIGS. **10** and **11**, the vertical position of the cylinder assembly **12** relative to frame **14** may be adjusted by turning adjustment nut **23** using handles **21** to position nut **23** at the appropriate position along the length of cylinder **22**.

In the preferred embodiment, the range of adjustment for cylinder **22** provides a drop height range between 1 inch and 47 inches. Port **40** is located at the lower end of cylinder **22** to allow nut **23** to be threaded over the top of cylinder **22** and to place mating hydraulic lines below top plate **62**. Port **40** could be located on the top of cylinder **22** which may eliminate the need for the concentric type double hydraulic cylinder, however, a cumbersome pipe is required, i.e. large enough to allow the volume of hydraulic fluid to evacuate the cylinder without restricting the drop rate of the piston (and therefore the weight). Such a pipe may obstruct adjustment nut handles **21**. Accordingly, there are no pipes or hydraulic lines extending above top plate **62** (or the portion of cylinder **22** extending above top plate **62**) in the preferred embodiment.

As best seen in FIGS. **10**, **11**, and **16**, base **60** is connected to the lower ends of upright channels **56** and **58** and a gusset **68** is attached between base **60** and each upright channel **56** and **58**. As shown in FIGS. **16–18**, ground contacting mechanism **66** is housed in base **60** and comprises wheels **70** rotatably attached to wheel spindle **72** which is retained in axle carrier **74**. Axle carrier **74** passes through rectangular passageway **76** provided in base **60**. Weight-on-wheels switch **79** is provided to indicate when breaker **10** is in its proper operating position, near the ground, preferably within three inches of the ground. Switch **79** is mounted on base **60**, extending from the top of base **60** into passageway **76** such that as the inventive breaker **10** nears the ground, the axle carrier **74** moves upward towards the upper surface of passageway **76** thereby actuating switch **79**. This position is depicted by FIG. **18**. Conversely, as the breaker **10** moves away from the ground, axle carrier **74** moves towards the lower surface of passageway **76** and switch **79** is not actuated. This position is depicted by FIG. **17**.

Referring next to FIG. **6**, weight **16** is slidably retained for vertical movement between left upright channel **58** and right upright channel **56** (as viewed by the operator). Bracket **78** is provided on the top of weight **16** to pivotally attach weight **16** to clevis **54** with clevis pin **80**. As stated above, clevis **54** is a ball joint clevis in the preferred embodiment, however, other known clevis or ball joint constructs could be substituted. Weight **16** is thus operably engaged to rod **46** and is raised and lowered in response thereto.

Referring again to FIG. **1**, tool receptacle **82** provided on the bottom of weight **16** includes aperture **84** which receives pin **86** to removably retain tool **88** within tool receptacle **82**. In the preferred embodiment, the combined weight of weight **16** and tool **88** is approximately one thousand pounds, however, it will be obvious to those skilled in the art that a wide range of weights may be employed depending on the size of the host machine and the thickness of the concrete, asphalt, or other desired material to be broken.

The closed hydraulic system **18**, as shown in FIG. **8**, includes first chamber **32** and second chamber **34** described hereinbefore, hydraulic power source **18** which is preferably integral to the host equipment **20** (FIG. **9**), valve **90** having a closed position and an open position, actuator **182** for operation of valve **90**, supply line **92**, return line **94**, and one-way check valve **96** which precludes operation of the inventive breaker **10** if the supply line **92** and return line **94** are inadvertently reversed or the operator reverses the direction of flow.

Actuator **182** is an electrically operated valve to control the flow of hydraulic fluid from valve **90** which is hydraulically operated. As can be seen, actuator **182** has a closed position **184** and an open position **186**. A solenoid **188** positions actuator **182** between closed position **184** and open position **186** in response to an electrical signal from timer circuit **106** (FIG. **19**). When electricity is sent to solenoid **188** from timer circuit **106**, actuator **182** moves from closed position **184** to open position **186**. When actuator **182** is in open position **186**, the hydraulic fluid pressure drops in dump valve **90**. In response to this pressure drop, spring **190** moves dump valve **90** from its closed position **91** to its open position **93**. When dump valve **90** opens, hydraulic fluid flows unrestricted and rapidly from first chamber **32** through port **33** through valve **90** and into second chamber **34** thereby allowing piston **30** (and thereby weight **16**) to drop freely (unrestricted) within first chamber **32**.

The hydraulic system does not require a vented reservoir, or, if the host equipment has a vented reservoir, the amount

of fluid stored in the reservoir is kept relatively constant, as the breaker **10** is operated, to substantially reduce venting, and thus the hydraulic system is referred to as a closed system.

Closed hydraulic system **18** also includes a relief valve **180**. Relief valve **180** protects hydraulic system **18** from overpressure and is designed to allow hydraulic fluid to escape directly from the supply line **92** to the return line **94** in such a situation.

Reference is next made to FIG. **19** which shows an electrical diagram for timer circuit **106** of the present invention. Electrical power is supplied by the host vehicle in a conventional manner through positive cable **198** and negative cable **200**.

Weight-on-wheels switch **79** and height trip switch **194** are wired in series and the series combination is electrically connected to the trigger input **206** of delay on break timer **196**. Both weight-on-wheels switch **79** and trip switch **194** are in a normally open position when the device is not activated. Therefore, both conditions must be met, the breaker **10** must be near the ground and the weight **16** must be lifted to the preselected height, before delay on break timer **196** will be activated to drop the weight **16**.

Delay on break timer **196** includes common contact **202** and normally open relay contact **204** electrically connected thereto. Positive voltage from the skid steer is applied to common **202** and normally open contact **204** is connected to the valve solenoid **188** such that when delay on break timer **196** is not triggered, normally open contact **204** is not electrically connected to common contact **202** and therefore, valve solenoid **188** is not activated. When delay on break timer **196** is triggered, normally open contact **204** is driven into contact with common contact **202** thereby supplying electricity to valve solenoid **188** which activates actuator **182** to open position **186** (FIG. **8**).

The delay on break timer **196** of the timer circuit **106** in the preferred embodiment is a KSDB 110.6SP solid state delay on break timer (relay timer) available from SSAC. However, it is understood that other suitable timer circuits could be substituted without departing from the spirit and scope of the invention.

Delay on break timer **196** sends power to solenoid **188** for a preselected period of time, preferably the amount of time required for the weight to fall to the paved surface (0.6 seconds in the preferred embodiment). Accordingly, valve **90** remains open during this time as discussed above with regard to FIG. **8**. Once the preselected time elapses, normally open contact **204** opens and power ceases to be sent to solenoid **188**. This drop cycle shall be discussed further below.

To use the inventive device for breaking a paved surface **101** (FIG. **2** in combination with FIG. **9**), it is first attached to a suitable host **20** such as a skid steer or backhoe via mounting bracket **22**. Next, the breaker is connected to the host hydraulic supply line **92** and to the host return line **94** (of FIG. **8**). The host **20** is then used to position the breaker **10** over the surface to be broken **101** and the breaker **10** is lowered until it is sufficiently close to the ground as determined by weight-on-wheels switch **79**, resting on wheels **70**. The host hydraulic system is then activated to supply hydraulic fluid under pressure to the breaker through the supply line **92** and to receive hydraulic fluid from the breaker through the return line **94**.

Referring back to FIG. **8**, upon activation of the host hydraulic system, valve **90** will be in its closed position **91** so that hydraulic fluid will flow through port **33** into first chamber **32** lifting piston **30** and thereby lifting weight **16**. This operation is depicted in FIG. **1**. As piston **30** moves upward, hydraulic fluid is forced from second chamber **34** through return line **94** back to the host. Upon weight **16** reaching a preselected height, the trip switch **194** of timer circuit **106** is activated which directs valve **90** to its open position **93** thereby shunting the supply line **92** to the return line **94** and providing a direct path for hydraulic fluid to flow from first chamber **32** to second chamber **34** allowing the weight to rapidly pull the piston down without substantial resistance from the hydraulic fluid being evacuated from first chamber **32**. This operation is depicted in FIG. **2**. Delay on break timer **196** preferably holds valve **90** in its open position **93** for a slightly greater period of time than is required for weight **16** to drop. Upon expiration of the preselected time period (0.6 seconds in the preferred embodiment), the timer directs valve **90** to its closed position **93** thereby allowing hydraulic fluid to fill first chamber **32** to again lift weight **16**. The cycle repeats automatically until the hydraulic system is deactivated by the host (skid steer or backhoe) operator by ceasing the flow of hydraulic fluid or lifting breaker **10**.

In the preferred embodiment, the trip switch **194** is wired in series with the weight-on-wheels switch **79** such that the signal indicating the weight **16** has reached its preselected height will not be received by the delay on break timer **196** if the weight of the breaker **10** is not sufficiently close to the ground. Therefore, the weight **16** will be lifted to the top of its range of movement within frame **14** (at this point, the relief valve **180** actuates to relieve the hydraulic fluid pressure) but the weight **16** will not drop until the breaker **10** is properly positioned such that weight on wheels switch **79** (and height trip switch **194**) is closed.

An alternate embodiment **150** of the inventive breaker is depicted in FIGS. **12–15**. In this embodiment, a hydraulic cylinder **158** is attached to the frame **14**. Hydraulic cylinder **158** could be a conventional hydraulic cylinder as shown or a double type hydraulic cylinder as described above. Pulley **152** is attached to cylinder rod **154**. One end of cable **156** is attached to pulley bracket **159** and then threaded over pulley **160**, back around pulley **152**, and over pulleys **162** and **164**. The remaining end of cable **156** is attached to clevis **166** which is pivotally attached to bracket **78** on weight **16** with clevis pin **80**. This pulley and cable arrangement results in a motion amplifier wherein any movement of the rod **154** results in a three times greater movement of the weight **16** thereby reducing the required stroke length of hydraulic cylinder **158** to achieve a given lift distance of weight **16**.

In operation, hydraulic fluid is pumped into first chamber **172** through port **216** of hydraulic cylinder **158** pushing the piston downward to lift weight **16** and expel fluid from second chamber **170** through port **218**. FIGS. **12** and **13** depict embodiment **150** with the weight **16** shown in a partially lifted position with cylinder rod **154** driven to a retracted position. In this position pulleys **152** and **160** have a relatively large separation. When weight **16** is lifted to a preselected height, valve **90** (FIG. **8**) is directed to its open position **91** allowing hydraulic fluid to flow directly from second chamber **170** into first chamber **172** thereby allowing the weight to drop. FIGS. **14** and **15** depict embodiment **150** with the weight **16** shown in its dropped position with cylinder rod **154** in an extended position. In this position, pulleys **152** and **160** are relatively close together.

It will be apparent to those skilled in the art that while the regenerative hydraulic cylinder arrangement is advantageous to embodiment **150**, similar results could be achieved with a 3-way hydraulic valve which will direct fluid to and

from the host transport rather than directly into the opposite chamber. However, there would be high pressure losses in host piping and greater restriction to the piston, and thereby the weight, falling.

As will be further understood by those skilled in the art, although embodiment **150** of the inventive breaker has been explained with reference to movement amplifier which provides three times the movement of the weight as that of the cylinder rod, there are numerous arrangements of pulleys and cables which would provide satisfactory operation of the breaker with a wide range of movement amplification, including fractional values of thereof.

As will be understood by those skilled in the art, although the preferred embodiments of the inventive apparatus **10** and **150** have been described as incorporating a single hydraulic cylinder, the inventive apparatuses could optionally utilize two, three, or more hydraulic cylinders. Further, although the hydraulic cylinder is herein described as a double cylinder, many variations could be utilized in the present invention including a conventional, off-the-shelf hydraulic cylinder.

As will also be understood by those skilled in the art, although the inventive apparatus has been described with reference to a height adjustment system utilizing a hydraulic cylinder assembly including an adjustment nut threaded over a hydraulic cylinder having a threaded outside surface, the height adjustment system could achieve similar results in a number of ways including a rack and pinion mechanism, a series of vertical apertures with a retaining pin, or any other similar mechanism.

As also will be understood by those skilled in the art, although the above-described preferred embodiment of the inventive apparatus has been explained with reference to a single weight, any number of weights could be employed in the present invention.

It will be further understood by those skilled in the art that the inventive apparatus can be employed with generally any type of host equipment which includes a hydraulic and electrical power supply.

Thus, the present invention is well adapted to carry out the objects and attain the ends and advantages mentioned above as well as those inherent therein. While presently preferred embodiments have been described for purposes of this disclosure, numerous changes and modifications will be apparent to those skilled in the art. Such changes and modifications are encompassed within the spirit of this invention as defined by the appended claims.

What is claimed is:

1. A device for attachment to a host including a hydraulic power supply conveying hydraulic fluid through a supply line and a return line comprising:

(a) a hydraulic system including:

(a)(i) at least one regenerative type hydraulic cylinder having a first chamber, a second chamber, and a piston separating said first chamber and said second chamber;

(a)(ii) said first chamber being in fluid communication with the supply line and said second chamber being in fluid communication with the return line;

(a)(iii) said first chamber being in fluid communication with said second chamber; and

(a)(iv) at least one valve capable of actuation between a first position and a second position wherein when said at least one valve is in said first position, the hydraulic fluid flows from the supply line to said first chamber and from said second chamber to the return line and when said at least one valve is in said second position, the hydraulic fluid flows from said first chamber to said second chamber;

(b) a frame supporting said hydraulic cylinder; and

(c) at least one weight capable of travel relative to said frame in response to actuation of said at least one valves.

2. The device for attachment to a host of claim **1** wherein said piston is capable of movement within said at least one regenerative type hydraulic cylinder;

a rod connected to said piston such that a movement of said piston results in corresponding movement of said rod;

said at least one weight being operably supported from said rod such that movement of said rod results in movement of said at least one weight relative to said frame.

3. The device for attachment to a host of claim **1** further comprising:

(d) at least one pivotable joint wherein said hydraulic cylinder is operably attached to said at least one weight by said at least one pivotable joint.

4. The device for attachment to a host of claim **3** wherein said pivotable joint includes:

(d)(i) at least one cable.

5. The device for attachment to a host of claim **1** further comprising:

(d) a motion amplifier wherein said hydraulic cylinder is operably attached to said at least one weight by said motion amplifier.

6. The device for attachment to a host of claim **5** wherein said motion amplifier includes:

(d)(i) a cable having at least a first end wherein said first end is attached to said weight; and

(d)(ii) at least one pulley wherein said cable traverses said at least one pulley such that a movement of said hydraulic cylinder results in a movement of said at least one weight of at least the same distance of said movement of the hydraulic cylinder.

7. The device for attachment to a host of claim **1** further comprising:

(d) a cable having a first end, said first end attached to either said at least one weight or said hydraulic cylinder; and

(e) at least one pulley wherein said cable traverses said at least one pulley such that a movement of said hydraulic cylinder results in a movement of said at least one weight.

8. The device for attachment to a host of claim **1** wherein said hydraulic system is a closed system.

9. The device for attachment to a host of claim **1** further comprising:

(d) a sensor which produces binary states such that when said weight is below a preselected height, said sensor will produce a first binary state and when said weight is lifted to said preselected height, said sensor will produce a second binary state.

10. The device for attachment to a host of claim **9** further comprising:

(e) a least one timer including an input for receiving said binary states from said sensor,

wherein when said timer receives said first binary state, said timer directs said valve to its said first position and when said timer receives said second binary state, said

timer directs said valve to its said second position for a preselected period of time and thereafter, upon receiving said first binary state, said timer again directs said valve to its said first position.

11. The device for attachment to a host of claim **1** wherein said at least one regenerative type hydraulic cylinder includes a double cylinder arrangement.

12. The device for attachment to a host of claim **1** wherein said at least one regenerative type hydraulic cylinder includes a concentric double cylinder arrangement.

13. A system for ensuring proper positioning of a device for breaking a paved surface for attachment to a skid steer or backhoe including a hydraulic power supply conveying hydraulic fluid through a supply line and a return line, comprising:

(a) a frame;

(b) a hydraulic system including:

(b)(i) a hydraulic cylinder having a rod; and

(b)(ii) a valve having at least a first position and a second position;

(c) a weight slidably retained in said frame, said weight being capable of travel within said frame in response to movement of said rod;

(d) a ground contacting member attached to said frame; and

(e) a sensor for sensing contact between the ground and said ground contacting member such that said sensor produces an output indicative of said contact,

wherein, when said valve is in said first position, hydraulic fluid is directed from said supply line to said hydraulic cylinder thereby moving said weight to an upper position,

wherein, when said valve is in said second position, hydraulic fluid is allowed to flow from said hydraulic cylinder thereby allowing said weight to fall to a lower position; and

wherein, when said output indicates that said ground contacting member is not contacting the ground, said valve is directed to one of said first or second positions.

14. The system of claim **13** wherein said hydraulic cylinder includes a double cylinder arrangement.

15. The system of claim **13**, further including:

a cable having at least a first end wherein said first end is attached to said weight; and

at least one pulley wherein said cable traverses said at least one pulley such that a movement of said hydraulic cylinder results in a movement of said weight of at least the same distance of said movement of the hydraulic cylinder.

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